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Innovative nuggets with pangasius fish and moringa leaf flour to enhance adolescent girls' health

Inovasi nugget dengan ikan patin dan tepung daun kelor untuk meningkatkan kesehatan remaja putri

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Abstract

Chronic energy deficiency (CED) in Indonesian adolescent girls is primarily caused by an unbalanced diet that leads to energy and protein deficiencies. Understanding how CED affects the physical development and health of girls is crucial as it may potentially impact their quality of life in the future. This study aimed to evaluate the acceptability and protein content of nuggets formulated with pangasius and moringa leaf flour. The true experimental design was the Testing Service Unit Laboratory, Faculty of Pharmacy, Universitas Airlangga, from April to July 2024. Nuggets with three different formulations were tested organoleptically by 25 panelists, and organoleptic data were analyzed using SPSS and statistically tested using Non-Parametric Testing. The results indicated that NG02 had the highest organoleptic scores for color, aroma, and taste, whereas NG01 had the highest protein content (15.36 %). Statistical analysis revealed no significant differences ($p > 0.05$) in color, taste, aroma, or texture among the three formulations. In conclusion, despite NG02 being the preferred protein, NG01's higher protein content suggests that it may better address CED in adolescent girls.

Keywords: Adolescent, chronic energy deficiency, nugget innovation

Abstrak

Kekurangan energi kronis (KEK) pada remaja putri di Indonesia terutama disebabkan oleh pola makan yang tidak seimbang, yang mengakibatkan kekurangan energi dan protein. Memahami bagaimana KEK mempengaruhi perkembangan fisik dan kesehatan remaja putri ini sangat penting, karena dapat berdampak pada kualitas hidup mereka di masa depan. Penelitian ini bertujuan untuk mengevaluasi tingkat penerimaan dan kandungan protein nugget yang diformulasikan dengan tepung ikan patin dan tepung daun kelor. Desain eksperimental sejati diterapkan di Laboratorium Unit Layanan Pengujian Fakultas Farmasi, Universitas Airlangga, dari April hingga Juli 2024. Nugget dengan tiga formulasi berbeda diuji secara organoleptik oleh 25 panelis, Data organoleptik yang dikumpulkan dianalisis menggunakan program SPSS dan diuji secara statistik dengan Uji Non Parametrik.. Hasil penelitian menunjukkan bahwa NG02 menerima skor organoleptik tertinggi untuk warna, aroma, dan rasa, sementara NG01 memiliki kandungan protein tertinggi sebesar 15,36%. Analisis statistik menunjukkan tidak ada perbedaan signifikan ($p > 0,05$) dalam warna, rasa, aroma, dan tekstur di antara ketiga formulasi. Kesimpulan, meskipun NG02 paling disukai, kandungan protein NG01 yang lebih tinggi menunjukkan bahwa nugget ini mungkin lebih baik dalam mengatasi KEK pada remaja putri.

Kata Kunci: Kekurangan energi kronis, inovasi nugget, remaja putri

Introduction

Nutritional problems in Indonesia often affect vulnerable groups, but this study focused on adolescent girls who are at a high risk of Chronic Energy Deficiency (CED). CED is a serious nutritional problem faced by adolescent girls in Indonesia, primarily because of inadequate nutritional intake, especially energy and protein intake (Sari et al., 2022; Utari & Al Rahmad, 2022). Improving a balanced diet from adolescence is crucial to prevent CED in adolescent girls, which can subsequently affect their health as they transition into adulthood and pregnancy (Harna et al., 2024; Mahjuri et al., 2021; Mutalazimah, 2020; Permana et al., 2020; Al Rahmad, 2023). To prevent CED in pregnant women, a balanced consumption pattern must be improved from adolescence onwards (Fauziyah, 2020; Lipoeto et al., 2020; Utami & Ani, 2023; Wati et al., 2024; Yulia et al., 2024).

In a survey of women aged 15-49 years was known that 54.01% became pregnant for the first time at > 20 years (ideal age of pregnancy). The remaining 23.79% were pregnant for the first time at the age of 19-20 years, 15.99% were pregnant for the first time at the age of 17-18 years, and 6.21% were pregnant for the first time at the age of 16 years and younger (Kementerian Kesehatan RI, 2018). This shows that half of the women who have been pregnant in Indonesia experience their first pregnancy at a young age or adolescence (Hermawan et al. 2023; Hu et al. 2020). Adolescent girls who do not improve their nutritional status are at risk of becoming stunted mothers (Mutiarasari et al. 2021; Yani et al., 2023). One way to overcome CED is to increase the protein intake (Flora, 2022), which is important for the maintenance and repair of body tissues (Angraini et al., 2023; Davies-Kershaw et al., 2024; Fitriani et al., 2020).

Transforming the health of adolescent girls is important in efforts to improve their nutritional status and future health (Choedon et al., 2024; Wrottesley et al., 2023), which is a crucial phase that affects their quality of life later in life (Heslin & McNulty, 2023; Nugroho et al., 2023). This study added pangasius fish flour and moringa leaves to increase the protein content and help overcome CED in adolescent girls. Nugget products are among the foods in high demand, particularly for children and adolescents (Keller et al., 2022). Moringa leaves (*Moringa oleifera*) are high-quality foods rich in proteins, vitamins, and minerals (Putra et al., 2021). These leaves also contain antioxidants that are beneficial to human health (Gong 2021; Ntshambiwa et al. 2023; Peñalver et al. 2022; Perveen et al. 2023). Moringa leaves can be processed into flour to extend their shelf life and facilitate their storage (Adam, 2020).

Nuggets can be developed by adding Moringa leaf flour and pangasius fish flour (Eliza, 2023). Pangasius has high protein content, which is beneficial for body growth (Abdullah et al., 2020). Pangasius is rich in omega-3 fatty acids and beneficial for brain development (Yaqin, 2021).

It is hoped that innovations in the development of this nugget will help overcome nutritional problems among adolescent girls in Indonesia, especially CED. Thus, the consumption of nuggets enriched with moringa leaves and pangasius can be a solution to health transformation and improve the nutritional status of adolescent girls who are at a risk of developing CED. The aim of this study was to evaluate the acceptability and protein content of nuggets formulated with pangasius fish and moringa leaf flours to address CED in adolescent girls.

Methods

This study employed a true experimental research design with a randomized control group, and was conducted from April to July 2024 at the Service Unit Laboratory, Faculty of Pharmacy, Universitas Airlangga. In this study, three nugget formulations containing pangasius fish flour and moringa leaf flour with variations in pangasius fish flour content of 5%, 10%, and 25% and moringa leaf flour content of 10%, 10%, and 15% of the total requirement were tested. The independent variable was the nugget formulation, whereas the dependent variables were the results of the organoleptic tests and the protein content of each nugget formulation.

The data collection involved two stages. The first stage was the organoleptic test, which included 25 panelists selected based on the inclusion criteria, such as being aged 18-45 years and having no allergies to the tested ingredients. The panelists assessed the color, taste, texture, and aroma of the nuggets using a validated rating scale. The nuggets were

presented in random order to avoid bias, and the evaluation was conducted in a controlled environment to maintain consistency. In the second stage, the protein content of the nuggets was analyzed using the Kjeldahl method in the laboratory, and each sample was tested in triplicate to ensure accuracy.

Data from the organoleptic tests were analyzed using the Kruskal-Wallis test to determine differences between nugget formulations, followed by the Mann-Whitney test for further analysis if significant differences were found. The protein content data were analyzed descriptively to determine the differences in protein content among the nugget formulations. A flowchart illustrates the research steps, starting with sample collection, panelist training, organoleptic testing, data analysis of organoleptic tests, protein content testing, and interpretation of the results. This study was approved by the Ethics Commission of the Ministry of Health Surabaya (ethical number EA/2209.2/KEPK-Poltekkes_Sby/IV/2024).

Result and Discussion

In this study, nugget products were developed by adding pangasius and moringa leaf flours. These nuggets are made from chicken and processed with the addition of pangasius and moringa leaf flour. The additional ingredients included wheat flour, eggs, finely ground garlic, pepper, white bread, and salt. The difference in composition lies in the use of chicken, pangasius fish flour, and moringa leaf flour with the three different formulations.

Table 1. Formulation of pangasius fish flour nugget and moringa leaf flour

Details	Nugget Formulation*		
	NG01	NG02	NG03
Chicken	500	480	490
Pangasius Fish Flour	5	25	10
Moringa Leaf Flour	10	10	15

*Data in grams (g)

Table 1 shows the formulation of the three nugget variations, namely, NG01, NG02, and NG03. The addition of pangasius fish flour and moringa leaf flour aims to determine the nutritional content of the nuggets, especially the protein content, as well as the organoleptic characteristics of each formulation. Analysis of this nugget formulation revealed that variations in the use of chicken, pangasius fish, and moringa leaf flours resulted in significant variations in nutritional value and product characteristics. Pangasius fish flour, which is rich in protein and omega-3 fatty acids, was integrated into the formulation to increase the content of essential nutrients in nuggets. The use of moringa leaf flour as an additive provides additional benefits in the form of vitamins, minerals, and antioxidants, which can increase the nutritional value of the product.

Therefore, the development of nugget formulations that consider the balance between nutritional content and sensory characteristics is key to creating products that are healthy and loved by consumers. Based on the Recommended Dietary Allowance (RDA) for the protein needs of adolescent girls, which is 65 g/day (Kementerian Kesehatan, 2019), these nuggets can act as a snack with a daily protein contribution. Because these nuggets are intended to be snacks, the protein consumption from these snacks should be 10% of the daily requirement, which is approximately 6.5-grams of protein. Therefore, consuming two pieces of nuggets daily is sufficient to satisfy the protein requirements of a daily snack.

Table 2 shows the sensory characteristics of the three nugget variations, namely, NG01, NG02, and NG03. Regarding the sensory characteristics of the table above, there were significant differences among the three nugget variations NG01, NG02, and NG03. Color Cis the most important quality attribute. Although food products are highly nutritious and delicious, their less attractive appearance makes them less attractive to consumers (Suranadi et al. 2023). The formulation shows that NG01 and NG02 have a light green color, whereas NG03 tends to be darker. The addition of moringa leaf flour affected the color change in each formulation; the more moringa leaf flour was added, the more intense the color and the higher the average value. This is because of the high chlorophyll content in moringa leaves. Chlorophyll is a substance that gives leaves a natural green color. Therefore, the addition of

moringa leaf flour can affect the color of the nuggets produced (Balqis, 2019).

Table 2. Characteristics of pangasius flour nugget formulation and moringa leaf flour

Indicator	Nugget Formulation		
	NG01	NG02	NG03
Color	Bright Green	Bright Green	Green To Dark
Taste	Not Bitter, Savory	Not Bitter, Savory	Astringent, Savory
Aroma	Typical Nugget	Typical Nugget	Typical Nugget
Texture	Crispy, Dense	Crispy, Dense	Crispy, Dense

Table 3. Average assessment of organoleptic test formulation of pangasius fish flour and moringa leaf flour

Indicator	Nugget Formulation			
	NG01	NG02	NG03	Kruskal Wallis Test Value
Color	3.36	3.72	3.48	0.277
Taste	3.49	4.00	3.76	0.223
Aroma	3.64	3.76	3.60	0.577
Texture	3.52	3.40	3.76	0.368
Average	3.49	3.72	3.65	
Protein Content (%)	15.36	15.09	14.39	

In terms of taste, NG01 and NG02 have the same profile, namely, they are not bitter and savory, whereas NG03 shows a slightly spicy taste but is still savory. The difference in sensation that occurs between the two people can be caused by a difference in the sensation received due to the difference in the sensitivity level of the sensory organs, or due to a lack of knowledge of certain tastes. The addition of moringa leaf flour and pangasius fish flour can affect the taste of nuggets if the higher the amount of moringa leaf flour added, the more moringa leaves taste and the smaller the average taste value. Moringa has a specific taste that is similar to its weak aroma (Balqis, 2019). The taste of sepat is caused by the presence of tannins in the moringa leaf flour. When tannins enter the mouth, there is a clump of protein in the oral mucosa, resulting in a taste that is not liked by panelists (Balqis, 2019).

These three nugget variations had a consistent nugget aroma. The aroma plays an important role in determining the degree of assessment and quality of food ingredients (Noviyanti et al., 2016). When blanched for 5 min, fresh moringa leaves can activate enzymes that cause the Langu odor. However, in reality, the blanching process cannot remove the entire langu aroma but can reduce it; thus, the use of a large amount of moringa leaves still produces a distinctive aroma of moringa leaves. The more moringa leaves added, the smaller the aroma value of the chicken nuggets produced. Therefore, the addition of moringa leaf flour in large quantities can affect the aroma of the nuggets. The texture was maintained in crispy and dense form. This analysis shows that variations in the composition of materials can affect not only the sensory properties, but also consumer acceptance of the product.

Based on the results of the organoleptic test in Table 3, it can be seen that the nugget formulation with code NG02 received the highest rating from the panelists, with an average score of 3.72, which means it is in the category of color indicators. NG02 also had the highest score for the aroma indicator with an average of 3.76. Specifically, in terms of taste, NG02 recorded the highest score among the three formulations, with a score of 4, which shows that the panelists liked the taste of the nuggets. However, for the texture indicators, NG03 dominates, with an average score of 3.76, which is also in a similar category. This analysis revealed that variations in formulation can significantly influence consumer preferences for nugget products.

The results of the Kruskal-Wallis test in the table show that for the four indicators, namely texture, color, aroma, and taste, all p> values were 0.05. This indicates that there is no significant difference between the three nugget formulations with pangasius fish flour and moringa leaf flour based on organoleptic tests.

Specifically, the p-values for texture were 0.368, 0.277, 0.577, and 0.223, respectively. Therefore, it can be concluded that the variation in the nugget formulation did not result in a significant difference in the panelists' assessments of the four sensory indicators.

The results of the protein content test in nuggets formulated with pangasius fish flour and moringa leaf flour showed that the NG01 formulation, with a ratio of chicken, pangasius fish flour, and moringa leaf flour 500:5:10, had the highest protein content, which was 15.36%. The NG03 formulation with a ratio of 490:10:15 has the lowest protein content (14.39%.)

According to the Indonesian National Standard for chicken nuggets, the minimum protein content is 12% and the combination of chicken nuggets is at least 9% (Sinaga, 2019). Based on the results of the protein content of the three nugget formulations, the results of the analysis met the requirements of the SNI Chicken Nugget standard: from the three formulations in 50 g of nuggets for chicken nuggets, the combination exceeded 9%, namely 15.36% for formulation 1, 15.09% for formulation 2, and 14.39% for formulation 3.

This experimental study encountered several limitations in terms of planning, methods, and results. In terms of planning, some variables may not have been fully accounted for, potentially limiting the generalizability of our findings. Methodologically, the procedures for analysis and sampling might not have been optimal, which could have affected the accuracy and validity of the results. Additionally, while the study revealed variations in the nutritional values and sensory characteristics of nuggets, the analysis may not provide a comprehensive understanding of the relationship between composition and product quality. These limitations highlight the need for improvements in the planning, methods, and interpretation of results for future research.

Conclusion

The nuggets formulated with catfish flour and moringa leaf flour, particularly NG02, received the highest organoleptic ratings in terms of color, aroma, and taste, whereas NG01 had the highest protein content. There was no significant difference in sensory assessment between the three formulations.

Further research is needed to evaluate the protein content of the formulation of catfish flour and moringa leaf flour and compare it with chicken- and catfish-based nuggets to obtain more comprehensive results. Nugget formulations incorporating catfish meal and moringa leaf meal offer valuable opportunities to improve nutrient intake, particularly by increasing protein levels and adding essential nutrients.

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References

Abdullah, A. Z., Fitri, S. A., Muniroh, M., & Agustini, T. W. (2020). Patin (Pangasius hypophthalmus) fish protein concentrate alters insulin-like growth factor (IGF)-1 and igf binding protein (IGFBP)-3 levels in Sprague Dawley neonate rats-induced malnutrition. *Potravinarstvo Slovak Journal of Food Sciences*, *14*, 1066–1074. https://doi.org/10.5219/1394

Adam, A. (2020). Water and Microbial Contents in Moringa Oleifera Seed Flour as Food Supplement to Prevent Stunting. *Systematic Reviews in Pharmacy*, *11*(10), 694–697. https://doi.org/10.31838/srp.2020.10.102

Al Rahmad, A. H. (2023). Scoping Review: The Role of Micronutrients (Fe, Zn, Iodine, Retinol, Folate) During Pregnancy. *Jurnal Kesehatan Manarang*, *9*(1), 1–13. https://doi.org/https://doi.org/10.33490/jkm.v9i1.812

Angraini, D. I., Sulastri, D., Hardisman, H., & Yusrawati, Y. (2023). Angraini Model as Effort to Early Detection of Chronic Energy Deficiency in Pregnancy. *Jurnal Kesehatan Masyarakat*, *19*(1), 102–112.

https://doi.org/10.15294/kemas.v19i1.42212

Balqis, A.M. N. A. (2019). Pengaruh Penambahan Daun Kelor (Moringa oleifera lam) dan Tulang Ayam Terhadap Sifat Organoleptik dan Tingkat Kesukaan Nugget Ayam. *Jurnal Tata Boga*, *8*(2), 364–371.

Choedon, T., Brennan, E., Joe, W., Lelijveld, N., Huse, O., Zorbas, C., Backholer, K., Murira, Z., Wrottesley, S. V., & Sethi, V. (2024). Nutritional status of school-age children (5–19 years) in South Asia: A scoping review. *Maternal and Child Nutrition*, *20*(2), e13607. https://doi.org/10.1111/mcn.13607

Davies-Kershaw, H., Fahmida, U., Htet, M. K., Kulkarni, B., Faye, B., Yanti, D., Shinta, D., Zahra, N. L., Angelin, T. C., Madhari, R., Pullakhandam, R., Palika, R., Dasi, T., Fernandez Rao, S., Banjara, S. K., Selvaraj, K., Palepu, D. P., Yadev, D., Diouf, S., … Ferguson, E. (2024). Anthropometric, biochemical, dietary, morbidity and well-being assessments in women and children in Indonesia, India and Senegal: a UKRI GCRF Action Against Stunting Hub protocol paper. *BMJ Paediatrics Open*, *8*(Suppl 1), e001683. https://doi.org/10.1136/bmjpo-2022-001683

Eliza, E. (2023). Local Food Based Cookies Formulation High in Essential Amino Acids for Stunting Toddlers. *International Journal of Chemical and Biochemical Sciences*, *24*(5), 292–296.

Fauziyah, S. (2020). Performance Achievement of Nutritional Programs in Mulyorejo Public Health Center, Surabaya, Indonesia in 2018. *Systematic Reviews in Pharmacy*, *11*(9), 893–898. https://doi.org/10.31838/srp.2020.9.130

Fitriani, H., Setya R, A., & Nurdiana, P. (2020). Risk Factors of Maternal Nutrition Status During Pregnancy to Stunting in Toddlers Aged 12 – 59 Months. *Jurnal Keperawatan Padjadjaran*, *8*(2), 183–191. https://doi.org/10.24198/jkp

Flora, R. (2022). Effect of Nutritional Status and Protein Intake on Levels of Serum Albumin in Pregnant Women in Seluma District. *Southeast Asian Journal of Tropical Medicine and Public Health*, *53*, 630–641.

Gong, S. (2021). Research Progress on Nutrition, Function and Application of Moringa oleifera Leaves. *Science and Technology of Food Industry*, *42*(21), 435–444. https://doi.org/10.13386/j.issn1002-0306.2020100030

Harna, H., Rahmawati, R., Irawan, A. M. A., & Sa'pang, M. (2024). Prevalence and determinant factors of Chronic Energy Deficiency (CED) in pregnant women. *AcTion: Aceh Nutrition Journal*, *9*(1), 65. https://doi.org/10.30867/action.v9i1.1443

Hermawan, D. Y., Widyaningrum, H., Lee, S. F., Indarjo, S., Nugroho, E., Raharjo, B. B., Nisa, A. A., Ediyarsari, P., Wahyono, B., Isniyati, H., Wasono, E., Prihatno, B. E., & Rozali, A. (2023). Integration of Minimum Initial Service Package for Reproductive Health in the Sister Village Program. *Jurnal Kesehatan Masyarakat*, *19*(2), 287–294. https://doi.org/10.15294/kemas.v19i2.43465

Heslin, A. M., & McNulty, B. (2023). Adolescent nutrition and health: characteristics, risk factors and opportunities of an overlooked life stage. *Proceedings of the Nutrition Society*.

Hu, H., Zhao, X., & Tan, F. (2020). Research on the Status and Impact of Underage Girls'Arranged Marriage through Computer Collection and Analysis: - Indonesia's poor areas as an example. *2020 International Conference on Artificial Intelligence and Education (ICAIE)*, 168–171. https://doi.org/10.1109/ICAIE50891.2020.00046

Keller, K. L., Shehan, C., Cravener, T., Schlechter, H., & Hayes, J. E. (2022). Do children really eat what they like? Relationships between liking and intake across laboratory test-meals. *Appetite*, *172*, 105946. https://doi.org/10.1016/j.appet.2022.105946

Kementerian Kesehatan. (2019). *Peraturan Menteri Kesehatan Republik Indonesia Nomor 28 Tahun 2019*. *8*(5), 55.

Kementerian Kesehatan RI. (2018). *Kemenkes RI (2018) 'Buletin Stunting.'*

Lipoeto, N. I., Masrul, & Nindrea, R. D. (2020). Nutritional contributors to maternal anemia in Indonesia: Chronic energy

deficiency and micronutrients. *Asia Pacific Journal of Clinical Nutrition*, *29*(Suppl 1), S9–S17. https://doi.org/10.6133/apjcn.202012_29(S1).02

Mahjuri, M., Suryana, S., Fajri, T. K., & Al Rahmad, A. H. (2021). The Relationship between Nutritional Intake and Obesity in Children during the Covid-19 Pandemic. *JAND: Journal of Applied Nutrition and Dietetic*, *1*(2), 36-45.

Mutalazimah, M. (2020). Energy, protein intake and mid-upper arm circumference in pregnant women in boyolali regency, Indonesia. *Malaysian Journal of Medicine and Health Sciences*, *16*, 77–83.

Mutiarasari, D., Miranti, M., Fitriana, Y., Pakaya, D., Sari, P., Bohari, B., Sabir, M., Wahyuni, R. D., Ryzqa, R., & Hadju, V. (2021). A Determinant Analysis of Stunting Prevalence on Under 5-Year-Old Children to Establish Stunting Management Policy. *Open Access Macedonian Journal of Medical Sciences*, *9*(B), 79–84. https://doi.org/10.3889/oamjms.2021.5622

Noviyanti, S., Wahyuni, S., & Syukri, M. (2016). Analisis Penilaian Organoleptik Cake Brownies Subtitusi Tepung Wikau Maombo. *Jurnal Sains Dan Teknologi Pangan*, *1*(1), 58–66.

Ntshambiwa, K. T., Seifu, E., & Mokhawa, G. (2023). Nutritional composition, bioactive components and antioxidant activity of Moringa stenopetala and Moringa oleifera leaves grown in Gaborone, Botswana. *Food Production, Processing and Nutrition*, *5*(1), 7. https://doi.org/10.1186/s43014-022-00124-x

Nugroho, M. R., & Armeidi, E., (2023). Analysis of Indonesia's Nutritional Status Survey Results 2021–2022: Trend of Stunting Prevalence Rates in the Provinces of South Sumatera and Bengkulu Towards. *Journal of Health,* 10(1). 201-210

Peñalver, R., Martínez-Zamora, L., Lorenzo, J. M., Ros, G., & Nieto, G. (2022). Nutritional and Antioxidant Properties of Moringa oleifera Leaves in Functional Foods. *Foods*, *11*(8), 1107. https://doi.org/10.3390/foods11081107

Permana, B., Lindayani, L., Hendra, A., & Juniarni, L. (2020). *The Effect of yoga exercise on reducing blood pressure among elderly with hypertension: A systematic review*. repository.unar.ac.id.

Perveen, S., Sultan, M. T., Amir, M., & Usman Khalid, M. (2023). Moringa (Moringa oleifera): Multi-functional Role in Management of Malnutrition and Health Promotion. In *Neglected Plant Foods Of South Asia* (pp. 301–317). Springer International Publishing. https://doi.org/10.1007/978-3-031-37077-9_12

Putra, A. I. Y. D., Setiawan, N. B. W., Sanjiwani, M. I. D., Wahyuniari, I. A. I., & Indrayani, A. W. (2021). Nutrigenomic and Biomolecular Aspect of Moringa oleifera Leaf Powder as Supplementation for Stunting Children. *Journal of Tropical Biodiversity and Biotechnology*, *6*(1), 60113. https://doi.org/10.22146/jtbb.60113

Sari, P., Herawati, D. M. D., Dhamayanti, M., & Hilmanto, D. (2022). The Study of Nutrient Intake and Adolescent Girls' Quality of Life in a Rural Area of Indonesia. *Children*, *9*(8), 1248. https://doi.org/10.3390/children9081248

Sinaga, Y. C. (2019). *tode Kjedhal Di Balai Riset Dan Standardisasi Industri Medan."*. 4–16.

Suranadi, L., Putu, N., Suarningsih, Y., Chandradewi, A., & Sofiyatin, R. (2023). Pengaruh Substitusi Tepung Terigu dengan Tepung Ubi Jalar Terhadap Sifat Organoleptik dan Sifat Kimia Nastar Nabikajau. *Jurnal Ilmu Gizi Indonesia*, *4*(1). https://doi.org/10.57084/jigzi.v4i1.1027

Utami, N. W. A., & Ani, L. S. (2023). The Association of Family Characteristics with Dietary Diversity among Adolescent Girls in Denpasar City, Bali, Indonesia. *Amerta Nutrition*, *7*(4), 540–545. https://doi.org/10.20473/amnt.v7i4.2023.540-545

Utari, D., & Al Rahmad, A. H. (2022). Pengetahuan dan sikap ibu hamil dengan pola kepatuhan mengonsumsi tablet tambah darah di Kabupaten Aceh Timur. *Jurnal SAGO Gizi Dan Kesehatan*, *4*(1), 8–13. https://doi.org/10.30867/gikes.v4i1.247

Wati, E. K., Murwani, R., Kartasurya, M. I., & Sulistiyani, S. (2024). Determinants of chronic energy deficiency (CED) incidence

in pregnant women: A cross-sectional study in Banyumas, Indonesia. *Narra J*, *4*(1), e742. https://doi.org/10.52225/narra.v4i1.742

Wrottesley, S. V, Mates, E., Brennan, E., Bijalwan, V., Menezes, R., Ray, S., Ali, Z., Yarparvar, A., Sharma, D., & Lelijveld, N. (2023). Nutritional status of school-age children and adolescents in low- and middle-income countries across seven global regions: a synthesis of scoping reviews. *Public Health Nutrition*, *26*(1), 63–95. https://doi.org/10.1017/S1368980022000350.

Yani, M., Azhari, A., Al Rahmad, A. H., Bastian, F., Ilzana, T. M., Rahmi, C. R., Andriaty, S. N., Chanda, A., & Salsabila, S. (2023). The relationship between menarche and nutritional status in Junior High School students in Aceh Besar. A study from 30 years of armed conflict area, Aceh, Indonesia. *AcTion: Aceh Nutrition Journal*, *8*(4), 635–641. https://doi.org/10.30867/action.v8i4.1310

Yaqin, M. A. (2021). The Effect of Essential Amino Acid (Lysine) in Commercial Feed of Patin Catfish (Pangasius sp.). *World's Veterinary Journal*, *11*(2), 263–266.

Yulia, C., Rosdiana, D. S., Muktiarni, M., & Sari, D. R. (2024). Reflections of well-being: navigating body image, chronic energy deficiency, and nutritional intake among urban and rural adolescents. *Frontiers in Nutrition*, *11*. https://doi.org/10.3389/fnut.2024.1346929